

Experimental and Research Station,

Nursery & Market Garden Industries'

- - Development Society, Limited, - -

Turner's Hill, Cheshunt, Herts.

Fourth Annual Report,
1918.



CHESHUNT:

C. BUNCE, PRINTER, 73, TURNER'S HILL.

1919.

Experimental and Research Station,

Nursery & Market Garden Industries'

- - Development Society, Limited, - -

Turner's Hill, Cheshunt, Herts.

Fourth Annual Report,
1918.

CHESHUNT:

C. BUNCE, PRINTER, 73, TURNER'S HILL.

1919.

Nursery and Market Garden Industries' Development Society, Limited.

OFFICERS 1918-19.

President:

† H. O. LARSEN, Esq., J.P.

Hon. Treasurer:

† C. H. SHOULTS, Esq.

Committee of Management:

* PROFESSOR H. E. ARMSTRONG, Ph.D., LL.D., F.R.S.

A. S. BOWLBY, Esq., J.P., C.C. (Herts County Council).

† W. DYKE, Esq.

A. J. EDWARDS, Esq., J.P., C.C. (Essex County Council).

* PROFESSOR J. B. FARMER, M.A., D.Sc., F.R.S.

† E. HOLE, Esq.

† H. E. HONNOR, Esq.

† J. NIELSEN, Esq.

* SPENCER PICKERING, Esq., M.A., F.R.S.

† W. B. RANDALL, Esq.

* DR. E. J. RUSSELL, O.B.E., D.Sc., F.R.S.

* DR. J. A. VOELCKER, M.A., Ph.D.

Co-opted Members:

PROFESSOR V. H. BLACKMAN, M.A., Sc.D., F.R.S.

DR. F. KEEBLE, C.B.E., M.A., Sc.D., F.R.S.

Auditors:

MESSRS. GEORGE H. COBLEY & Co, 27, Southampton Street,
Strand, W.C.

Bankers:

THE LONDON JOINT STOCK BANK, LIMITED.

Solicitors:

MESSRS. HUTCHISON & CUFF, 6, Stone Buildings,
Lincoln's Inn, W.C.

Secretary:

A. B. LISTER, A.R.C.Sc., D.I.C., B.Sc.

* Nominated by the Committee of the Lawes' Agricultural Trust, Rothamsted,
Harpenden, Herts.

† Nominated by the Lea Valley and District Nurserymen's and Growers' Association,
Limited.

Experimental and Research Station.

DIRECTOR.

A. B. LISTER, A.R.C.Sc., D.I.C., B.Sc. (Lond.).

RESEARCH ASSISTANT FOR SOIL STERILISATION.

* MRS. D. J. MATTHEWS, M.Sc. (Vict.).

LABORATORY STAFF.

Laboratory and Office Assistant—Helen Marchant.

GLASSHOUSE WORKING STAFF.

Foreman	†A. A. Richards.
Temporary Foreman	H. G. Hollington.
Cucumber Grower.....	J. H. Smith.
Tomato Grower.....	A. E. Judd.
Gardener	A. J. Grundy.
Assistant	Florence King.

*Working for the present at the Rothamsted Experimental Station.

†Away on National Service.

HOUSES

TOMATO

SERIES K. SERIES J. SERIES H. SERIES G.

S.	O.	P.	S.
L.	N.	M.	L.
2	4	6	8
1	3	5	7
2	4	6	8
1	3	5	7
3		4	
2		1	
3		4	
2		1	

100 FEET



100 FEET

CUCUMBER HOUSES

SERIES C. SERIES X. SERIES D. SERIES E. SERIES F.

4		5		6	Corridor 6-13 FEET					
3		2		1						
4		5		6						
3		2		1						
4		5		6						
3		2		1						
10	11	12	13	14	15	16	17	18	Corridor	
9	8	7	6	5	4	3	2	1	Corridor	Botanical Laboratory
7		8			3		4			
6		5			2		1			

Corridor

Corridor

Corridor

SERIES A & B.

B.3.	B.4.	A.3.	A.4.
B.2.	B.1.	A.2.	A.1.

78 FEET

20 FEET

ISOLATION HOUSE

Botanical Laboratory

Chemical Laboratory

Office Dark Room Laboratory

Stokehole and Boiler

Garden Border

Stokehole and Boilers

Water Tower

Packing and Store Shed

Roadway

Roadway

Diagram to show arrangement of experimental plots



1918

General Report.

IT is a pleasure to be able to report that the Nursery and Market Garden Industries' Development Society continues to make steady progress, and that the industries concerned are recognising to an increasing extent the value of the Station. There are now 120 Shareholders, holding 457 Transferable Shares between them, and of these Shareholders, no less than 112 are Annual Subscribers to the Experimental Station Maintenance Account, which from this source alone benefits to the extent of £275 per annum. Thus not only has the original interest been maintained, but subscriptions have increased, in spite of the heavy demands on growers in other directions.

The Station has continued to feel disability in the matter of manual labour due to military requirements, but it is hoped that the Foreman will soon be free to return to his post at the Station, and that the output of useful work may be considerably increased in the near future.

During the year 1918 the Director made 509 technical and scientific reports, 358 being sent to growers in the Lea Valley district, and 151 to growers in other parts of Great Britain. At the request of members, the Director visited 161 nurseries, 145 in the Lea Valley district, and 16 outside, to report on matters coming within the scope of the work of the Station.

The number of visits from growers (or their representatives) and other interested persons during the year amounted to 1,054.

Seventeen samples of soil were examined with regard to lime requirements.

Many enquiries from allotment-holders have been answered, and spraying machines have been lent free of charge.

The experimental work has, to a large extent been a continuation of that undertaken in the previous year. New features have been the growing of cucumbers in two imported soils, one of which had always given good crops, while the other had failed to do so; an estimation of experimental error in cucumbers, a house being devoted to this object; an enlargement of the plots devoted to experimental error in tomatoes; the extension of the outside experiments in soil sterilisation to a third nursery; some preliminary work on methods of eradicating the caterpillar of the Noctuid moth—*Hadena oleracea*, which does so much damage to tomato crops under glass; and some growth measurements of cucumbers during the period that the plants occupied in growing from the first to the tenth training wire.

Experimental Records and Tables.

Sources of Error and Uncertainty.

(a.) Behaviour of Tomato plants according to their position in the house.

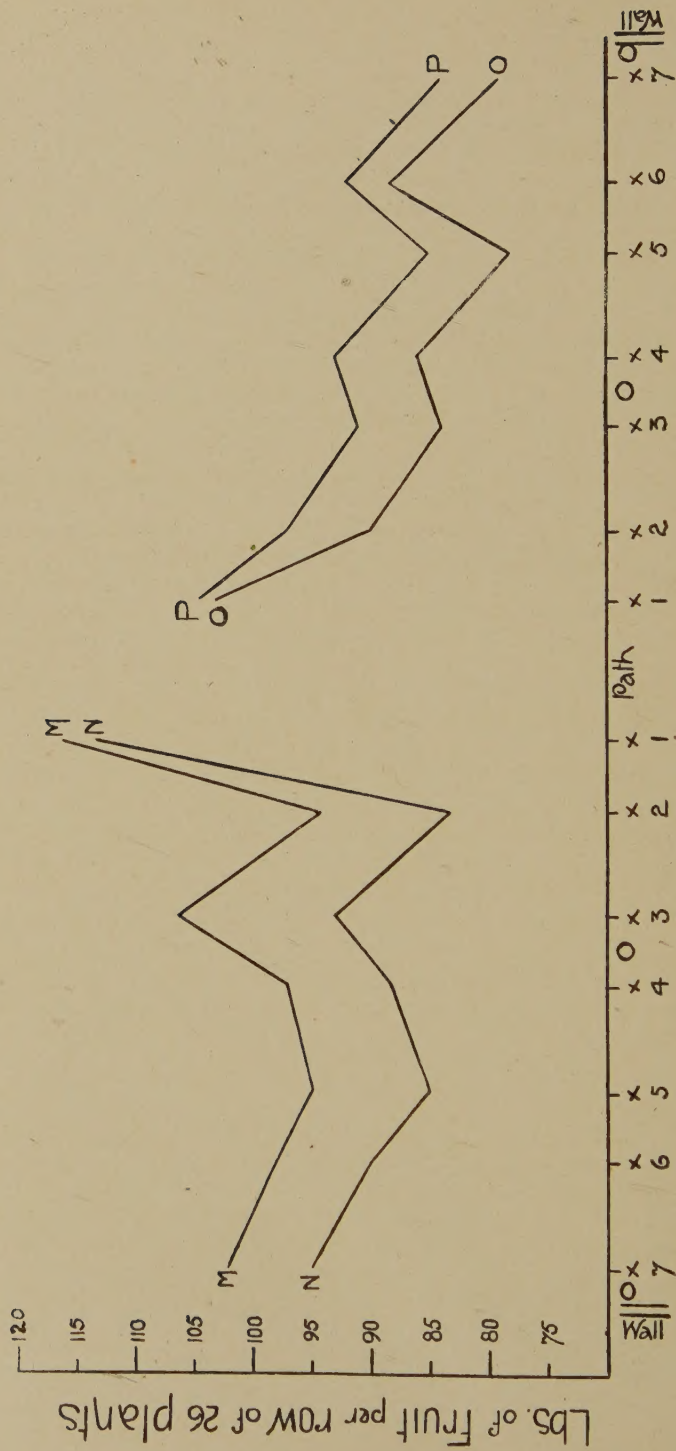
Last year two plots of tomato plants opposite each other on the two borders of House 5, gave somewhat remarkable results; the two rows next to the central path yielded very high values, and the other rows yielded alternately high and low values, the figures representing the total crops thus forming a more or less regular zigzag line. There were 17 plants of the variety "Comet" in each row, and the distances between the rows were alternately 18 and 27 inches. A further and more extended investigation of the subject was made this year in the same house, there being two plots of the variety "Ailsa Craig" facing each other (plots M. and P.), and two other plots, also facing each other, of the variety "Kondine Red" (plots N. and O.). The distances between the rows were alternately 18 and 27 inches, as last year. There were 26 plants in each row of M, N, O and P. The weights of fruit from them are given in Table I., and are represented diagrammatically in Fig. 1.

Table I.

Crops in lbs. per plant, grown in rows each containing 26 plants, and occupying 1/603 of a house acre.

Variety.—"Ailsa Craig."				Variety.—"Kondine Red."			
Row.	Lbs.	Row.	Lbs.	Row.	Lbs.	Row.	Lbs.
M1	4.48	P1	4.01	N1	4.33	O1	4.02
2	3.62	2	3.74	2	3.19	2	3.47
3	4.07	3	3.48	3	3.57	3	3.24
4	3.73	4	3.58	4	3.38	4	3.29
5	3.65	5	3.25	5	3.27	5	3.01
6	3.78	6	3.52	6	3.44	6	3.37
7	3.90	7	3.24	7	3.66	7	3.04

So far as the high values of the rows next the central path are concerned, they are as apparent as they were in 1917, though less marked on the right hand side of the house than on the left (the right hand side of this house is an outside wall, the left hand side being continuous with the adjoining House No. 4). Such high values, as explained in the last report, present no difficulties, for these rows have neighbouring rows of plants on one side of them only, instead of on both sides. Both in this and in all other respects, there is a marked concordance in the behaviour of the two varieties. So far as the zigzag character



Relative positions of plants (X), and hot water pipes (O)

of the results is concerned, this is somewhat less apparent than last year, and is shown chiefly in the rows of M. and N. which are nearer the centre of the house, and in the rows of O. and P. which are more remote from the centre of the house. That there is some circumstance, however, having a marked effect on the behaviour of the plants in the different rows, is evident from the close similarity of the behaviour of the two varieties on each side of the house. This experiment will be repeated and extended next year, devoting the whole of the house to the subject, for the results clearly show that the behaviour of plants according to their position and arrangement in the house is seriously affected by conditions which are at present obscure; and it is important to bear in mind that the differences due to these unknown causes are considerably greater than those produced in most cases by known cause, such as differences in manurial treatment, &c.

No opportunity, unfortunately, has yet occurred of examining the comparative behaviour of tomatoes at the hotter and cooler ends of the houses at our own Station, but as was the case last year, some data on the subject may be collected from the soil sterilisation experiments conducted in trade nurseries, though it must be remembered that the conditions there, especially those dependent on the size of the houses, may not be comparable with those in our own houses. The results were:—

Nursery No. 1, House A.		Nursery No. 2.	
Boiler end S. 100 (Steam).	N. 100 (Steam).	100 (Hot water).	
Other end N. 108	„ S. 80	„ 82	„

The values are not uniform in the two nurseries, but those in Nursery No. 2 point, as did the results in 1917, to a considerable difference in favour of the boiler end.

(b.) Behaviour of Cucumber plants according to position in the house.

The manurial experiments with cucumbers (Table VII.), wherein there were similar plots at both the boiler and the other ends of the houses, gave, as they did last year, a measure of the differences due to the position of the plants in this respect. The average difference of air temperature throughout the season in Series C, as between the boiler and the other end was 4°F., the corresponding difference in Series D., E. and F. being only 2°F. The greater difference observed in the case of the boiler end of House C., is due to the fact that there are here six rows of heating pipes, as against four only in the other half, whereas in all the other houses there are four in both halves. The percentage differences of yield from plots at the boiler ends and those from corresponding plots at the other ends were:—

D1,	D6,	F1,	F6,	E1,	E6,	C1,	C2,	C3,	C4,
—24	—11	—2	—6	—0	—2	—6	—6	+1	—17

giving a mean of -7 ; that is, the yield from the boiler ends was *less* than that from the other ends: last year, the results were just the reverse, so that when the values for the two years are taken together, there is no evidence that plants do better at the boiler than at the other end. This is contrary to the opinion generally held on the subject.

To get the experimental error shown by the present experiments when differences which may be due to the position of the plants in the house are eliminated, -7 must be subtracted from (*i.e.*, 7 must be added to) the above values, and we then get the following residues, which when arranged in their order of magnitude are:—

$-17, -10, -4, +1, +1, +1, +5, +5, +7, +8,$

the arithmetical mean of which is 6. This is rather smaller than the value obtained last year, which was 10, but the maximum differences observed are about the same; 17 per cent. this year, and 19 per cent. last year.

(c.) The relation of early stem-growth to crop in the case of cucumbers.

The relation between the early growth of cucumbers, as measured by the length of main stem formed after the plants were set out in their permanent quarters, and the weight of fruit eventually borne by them, was measured in the case of 18 sets of 4 plants each in Series X., where the manurial treatment was identical with that in Series E. 1 and 4 (Table VII.). The growth measurements of each plant were made daily from March 5th to April 4th inclusive, and the fruit records from March 27th to July 31st inclusive. The results are set out in Table II., the order in which the plants arrange themselves according to the length of growth and the weight of crop being shown in columns 3 and 5. A mere inspection of these columns, especially of the first entries in them, shows that the order of arrangement is very similar in the two cases. If there were no connection between the two features, and the arrangement in either case were a matter of mere chance, there would be an average difference of nine places between the order in the two columns, whereas the difference is found to be only 1.8 places. A more instructive method of examining the results, however, is to divide the crop measurements by the growth measurements, or *vice versa*, for if these two features are directly proportional to each other, such a process would give a constant. The results of such an operation are shown in column 7, the values being set out in the order of magnitude of the growth as given in column 6. There can be no doubt but that we do obtain a value which is very nearly constant, but by grouping the results into three lots so as to reduce the experimental error (and omitting the last entry which is obviously exceptional), it appears that the value is not quite constant, but varies pro-

Table II.
Relation of growth to crops in cucumbers.

Crops in lbs. per plot (8 ft. by 3 ft.) containing 4 plants and occupying 1/840 of a house acre.

Plot No. I.	CROPS.		GROWTH.		GROWTH VI.	CROP. GROWTH. VII.
	Lbs. II.	Order, III.	Inches. IV.	Order. V.		
XI	202.6	1	263.5	1	263.5	76.9
2	181.1	3	240.5	3	263.0	76.4
3	175.4	5	237.5	5	240.5	75.3
4	201.1	2	263.0	2	239.0	70.2
5	167.7	8	226.5	7	237.5	73.8
6	169.4	6	234.0	6	234.0	72.4
7	178.7	4	220.5	8 or 9	226.5	74.0
8	140.2	15	214.0	12	220.5	81.0
9	136.0	16	184.5	17	220.5	75.3
10	163.3	10	178.5	18	219.5	72.2
11	129.6	18	213.5	13	217.5	69.4
12	141.4	14	206.5	15	214.0	65.5
13	135.0	17	200.5	16	213.5	60.7
14	166.1	9	220.5	8 or 9	208.0	75.6
15	150.9	13	217.5	11	206.5	68.4
16	158.5	11	219.5	10	200.5	67.3
17	167.8	7	239.0	4	184.5	73.7
18	157.3	12	208.0	14	178.5	91.5

* Mean where the last exceptional entry is omitted.

Growth measurements were taken from March 5th to April 4th both inclusive, *i.e.* 31 days.

Fruit records commenced on March 27th and ended July 31st.

gressively with the vigour of the plants, so that whatever circumstance increases or diminishes the early growth, increases or diminishes the fruiting slightly more. These relations between growth in the early part of the season, and the weight of crop eventually borne by the plant, may prove of practical utility to the grower, but it must be borne in mind that at present it applies only to cases where the plants are all under strictly similar conditions. A proportionality between growth and cropping, even between certain restricted limits, has not yet been established in the case of hard-wooded or perennial plants, and beyond certain limits, there is undoubtedly a direct antagonism between the two: rampant growth is accompanied by poor crops or actual sterility, and excessive fruiting reduces growth, even to the extent of stunting or killing a tree. It would, however, be premature to conclude that there is anything fundamentally different in the behaviour of such plants, and that of cucumbers (or, possibly, of annuals in general), for the present results, besides referring only to *early* growth in its relation to the crops eventually produced, apply, also, only to cases where there is no excessive variation in growth—but 50 per cent. at the most—and where the plants are under no ab-

normal manurial conditions. It is possible that under other conditions the proportionality here found would no longer apply, and this is suggested by an examination of the growth of the plants in Series D., F. and E., where the manurial treatments were different, for, as shown by the results in Table III.,

Table III.

Relation of crops to early growth in cucumbers under the different manurial conditions entered in Table VII.

Plot Number.	Inches.	Relative to D 1 & 4.		Crop.
		Growth.	Crop.	
D 1	180.5	100	100	100
No Dung.	163.5			98
4	172.0			
2	191.0			
6	175.5			
3	188.0	106	111	105
5	193.0	112	110	98
F 1	174.0	94	126	134
Dung 33%.	149.5			126
4	170.0			
2	170.5			
6	163.0	91	117	121
3	166.0	96	113	118
E 1	197.5	103	126	122
Dung 50%.	158.0			114
4	199.0			
2	201.0			
6	170.0	108	122	113
3	186.0	108	122	113

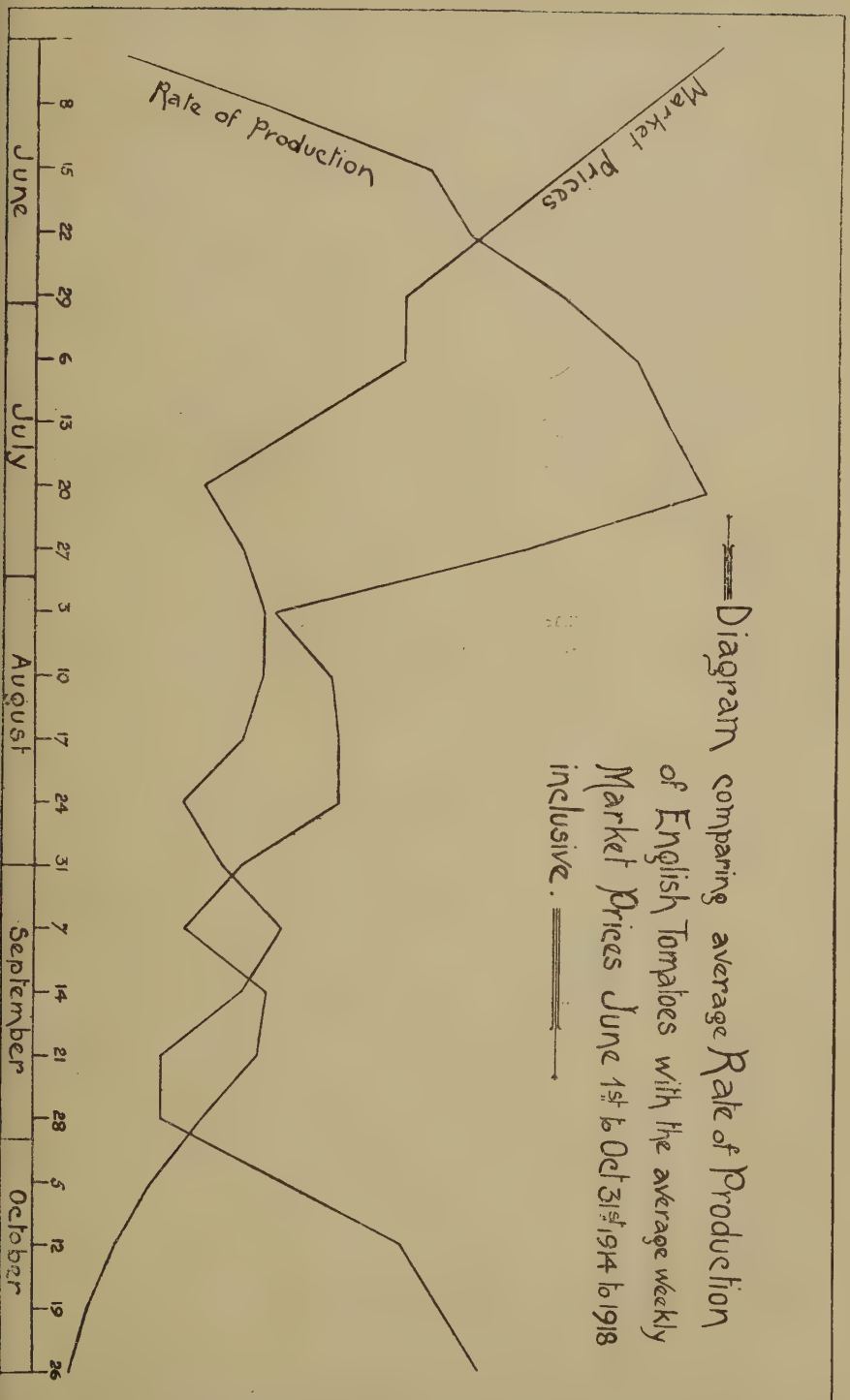
though each Series gives approximately a constant, that constant is certainly not the same in the three houses, and moreover, the house wherein least growth was exhibited (F.), is the one where the crop was the heaviest—just the reverse of the conditions shown in Table II. The results in the other two houses, however, do not show any reverse proportionality, so that no stress can be laid on such indications, beyond the necessity of confining our conclusions at present to cases where all the plants are under strictly similar conditions. The data here are, naturally, insufficient to lead to any conclusions as to the variation of the constant in the case of the different plots in each individual house when considered separately.

Experiments in the management and cultivation of Tomatoes.

(a.) Slow versus Forced Growth of Tomatoes.

This experiment was continued in the Isolation House exactly on the lines indicated last year, and did not on this occasion suffer from the disabilities of the first season's trial. The object of the experiment was to determine whether an earlier,

Diagram comparing average Rate of Production of English Tomatoes with the average weekly Market Prices June 1st to Oct 31st 1914 to 1918 inclusive.



and hence more valuable, crop can be obtained by taking the fullest advantage of the sun heat. The amount of artificial heat supplied is practically identical in the two series, as the heating pipes run right through the two sections of the house, but whereas in the forced section, no ventilation is given until the air temperature reaches 90°F. (accompanied by slight overhead dampings), in the slow section, ventilation is usually given when the air temperature reaches 70°F., and no overhead dampings are given at any time. If growers could utilise a portion of their glasshouse area for forced growth it would tend to relieve the market of the usually heavy glut of tomatoes in the months of June and July, and give the grower a corresponding increase in price proportional to the degree of earliness attained. It is not desirable to draw any very definite conclusions this year, as the Committee have decided to continue this experiment for one more year, the series being repeated in the reverse order to that of 1918, so far as the arrangement of the houses is concerned. The results given in Table IV. indicate that the increased early cropping due to for-

Table IV.

Crops in lbs. per plant, on plots (17 ft. by 8 ft.) containing 54 plants, and occupying 1/290th of a house-acre.

VARIETY.	Isolation House. Series A. Forced Growth.							Isolation House. Series B. Slow Growth.						
	June.	July.	August	Sept.	Oct.	Nov.	Total. lbs. per plant. Tons pr acre	June.	July.	August	Sept.	Oct.	Nov.	Total. lbs. per plant. Tons pr acre
"Fillbasket" ...	1.55	2.34	1.07	0.59	1.08	0.77	7.40	1.06	2.13	1.14	0.45	0.54	0.89	6.21
"Comet" ...	0.80	1.67	0.81	0.45	0.48	0.57	4.78	0.48	1.87	0.82	0.44	0.31	0.73	4.65
"Kondine Red"	1.24	2.24	0.74	0.44	0.73	0.68	6.07	0.51	2.42	0.76	0.56	0.63	0.73	5.61
"Ailsa Craig" ...	1.43	2.08	0.95	0.62	0.86	0.48	6.42	0.87	2.44	1.15	0.48	0.75	0.44	6.13
Relative Values	100	100	100	100	100	100	—	58	106	108	92	71	112	92
Tons per acre ...	8.78	14.6	6.24	3.68	5.52	4.38	—	5.10	15.5	6.76	3.37	3.90	4.87	—

* Including small pickings in May.

cing is confined to the month of June, after which the unforced plants forge ahead for two months, but the initial superiority of the forced crop is maintained throughout the season. The results, in the main, are very similar to those obtained last year, except that slow growth has not shown to such a great disadvantage in the first and last part of the season. As regards total crops there is probably nothing to be gained by forcing, this having resulted in a loss of 9 per cent. last year, and a gain of 8 per cent. this year.

The variety "Comet" is the least responsive to forcing of the four that have been tried, which is rather surprising in view of the fact that this variety is the most responsive, as described below, to overhead damping unaccompanied by modification of temperature.

It is proposed to re-arrange the varieties in the forcing experiments next year.

(b.) Overhead Damping versus Non-damping.

The experiment on overhead damping *versus* dry treatment, and the relative effects of these treatments on the setting of the fruit, was repeated this year in the first two of the large tomato houses, without any transposition of plots. In the two previous years House No. 2 (not damped 1916, damped 1917) had given the larger yield, irrespective of the treatment. This year it is House No. 1 (damped 1916, not damped 1917 and 1918) which has given better yields for all the varieties except "Comet." (See Table V.) The present experiments are to be

Table V.

Crops in lbs. per plant on plots (50 ft. by 12 ft. 6 in.) containing 250 plants, and occupying 5/348 of a house-acre.

VARIETY.	House No. 1. Series G. Not Damped.								House No. 2. Series H. Damped.							
	Lbs. per plant.						Total.		Lbs. per plant.						Total.	
	June.	July.	Aug.	Sept.	Oct.	Nov.	Lbs. per plant.	Tons per acre.	June.	July.	Aug.	Sept.	Oct.	No v.	Lbs. per plant.	Tons per acre.
"Pillbasket" ...	0.20	3.58	0.61	0.43	0.51	0.39	5.72	44.4	0.52	3.31	0.29	0.35	0.30	0.27	5.04	39.1
"Comet" ...	0.03	2.17	0.54	0.36	0.35	0.28	3.73	29.0	0.18	2.30	0.49	0.61	0.36	0.19	4.10	31.9
"Tuckswood" ...	0.06	2.81	0.75	0.51	0.35	0.24	4.72	36.7	0.22	2.55	0.67	0.42	0.26	0.28	4.40	34.2
"Ailsa Craig" ...	0.17	2.91	0.48	0.52	0.28	0.95	5.35	41.6	0.40	2.11	0.38	0.62	0.26	0.22	3.99	31.0
Relative Values	35	112	1.32	91	126	194	111	—	100	100	100	100	100	100	100	—
Tons per acre ...	0.9	22.4	4.6	3.5	2.9	3.6	—	37.9	2.6	20.0	3.5	3.9	2.3	1.8	—	34.1

repeated for one more season, the plots being transposed once more, *i.e.*, the damping will be done in the house that was kept dry this year and *vice versa*.

As regards the total yields, the omission of damping gave last year a decrease of 10 per cent., and this year an increase of 11 per cent., so that the effect on the total crop of the mixed varieties is probably nil. The reduction in the crop borne in the early part of the season if damping is omitted, may, however, be of commercial importance. The poor yield in June, and the improved yield in July and August, shown by the non-damped plants last year, is equally shown this year, but last year these plants fell off subsequently in September and October, whereas this year there was only a falling-off in September and then a considerable rise in October and November.

A more complete review of the results must be deferred till the end of next year.

As regards the exceptional behaviour of "Comet," as noted above, it seems to be a matter of general experience that it is a variety which freely responds to the overhead damping treatment as an aid to the setting of the fruit, and, as an instance of this, may be quoted the fact that in 1917, when all four varieties gave an increased yield in the house that happened to be damped, the greatest proportional increase was given by "Comet."

(c.) Stopping versus Non-stopping.

The detailed management of the tomato plant is a highly important factor in the production of fruit from it, and the question as to whether it is best to stop the plants at four or five trusses, and then allow them to run on, or to let the plants run straight on from the beginning, is one of the points in question, and its importance becomes enhanced when the supply of skilled labour is short. It is certainly safer to let plants run straight on when only unskilled labour is available, the training of the plants being then confined to removing axillary shoots, tying the stems to twine or cane, and cutting back the superfluous foliage. The operation of "stopping," the object of which is to assist the plant in ripening its first four or five trusses before expending energy on further growth, requires a certain amount of skill and discretion, as it is absolutely essential to provide for further growth by leaving an axillary shoot in a position suitable for the purpose. At the Station, experiments on the subject have been continued during the last three years, combining them with trials of varieties. In 1917 the stopped plants showed a superiority of 15 per cent. in the yield for June, and 23 per cent. in October; but in 1916 and this year the balance was uniformly in favour of the non-stopped plants in every month except July. So far as the total crop return is concerned, there is probably nothing in the treatment, the actual variations being well within the limits of experimental error.

The behaviour of the individual varieties is by no means uniform; in 1916, nineteen of the twenty-five varieties examined gave results in favour of non-stopping; in 1917, the results were equally for and against stopping, and this year, the six varieties examined gave uniformly better yields when not stopped. (See Table VI.) With such variations in behaviour, the adoption or non-adoption of stopping will probably be determined by each nurseryman for himself, after a consideration of the amount of skilled labour available, and of the convenience in working during the latter part of the season, for non-stopped plants grow so tall that a considerable amount of extra labour is entailed in keeping them properly trained.

Table VI.

Crops in lbs. per plant. Each plot contained 30 plants and occupied 1/581 part of a house acre.

VARIETY.	House No. 5. Series S. "Stopped."							House No. 5. Series L. "Non-Stopped."						
	Lbs. per plant.					Total.		Lbs. per plant.					Total.	
	June.	July.	Aug.	Sept.	Oct.	Lbs. per plant.	Tons pr acre.	June.	July.	Aug.	Sept.	Oct.	Lbs. per plant.	Tons pr acre.
Balch's Seedling A ...	0.84	1.91	0.60	0.44	0.29	4.08	31.7	0.88	2.13	0.69	0.79	0.56	5.05	39.2
.. .. B ...	0.59	2.28	0.46	0.39	0.14	3.86	30.6	0.61	2.22	0.51	0.42	0.35	4.11	31.9
.. .. C ...	0.45	2.10	0.44	0.53	0.33	3.85	29.9	0.47	2.36	0.58	0.33	0.48	4.22	32.8
Rochford's Improved "Ailsa Craig" ...	0.16	2.23	0.66	0.45	0.17	3.67	28.5	0.24	1.81	1.02	0.51	0.51	4.09	31.8
Knaresborough Wonder ...	0.10	1.87	0.48	0.31	0.23	2.99	23.3	0.17	1.53	0.80	0.61	0.37	3.48	27.0
"Ailsa Craig" x Bucks "Tresco" ...	0.08	2.48	1.26	0.34	0.30	4.46	34.7	0.09	2.16	1.16	0.76	0.67	4.84	37.6
Relative Values ...	100	100	100	100	100	100	—	112	95	122	139	201	113	—
Tons per acre ...	2.85	16.7	5.07	3.19	1.89	—	29.7	3.19	15.8	6.17	4.43	3.81	—	33.4

The Manurial Experiments. (a.) Cucumbers. (b.) Tomatoes.

There can be no doubt but that the soil at the Station still retains some of its virgin character, but the results this year are so similar to those obtained last year, that it has been decided to make some alterations in the series for next year, so that more definite information may be obtained as to the manurial requirements of cucumbers and tomatoes, respectively.

Three distinct series of experiments have been carried out during the last three years. In the first and second the object was to discover the fertiliser requirements of cucumbers and tomatoes, respectively, whilst the third, which was confined to tomatoes, consisted in applying varying proportions of a dressing selected by the growers as a "standard."

(a.) The manuring of cucumbers.

The experimental results obtained in Series D., E. and F. are given in Table VII., and again show the great value of dung in the culture of cucumbers, and that neither hoofs, bone-meal nor a mixture of the two are efficient substitutes for it. It is also shown that—in our own soil, at any rate—there is nothing gained by increasing the percentage of dung in the border beyond 33 per cent.

A summary of the three year's results is given in Table VIII., and it will be seen from the upper portion of this Table that the average increase produced by 33 per cent. of dung is

Table VII.

Manurial Experiments with Cucumbers.

In Series D., E. and F., crops in lbs. per plant, grown in borders (32 ft. by 3 ft.) containing 16 plants, and occupying 1/210th of a house acre.

In Series C, crops in lbs. per plant, grown in borders (18 ft. by 3 ft.) containing 9 plants, and occupying 1/373 of a house acre.

TREATMENT. (Lime added in all cases.)	Lbs. per plant.					Total.		Relative.	Relative compared with D1 & 4.*
	March.	April.	May.	June.	July.	Lbs. per plant.	Tons pr acre.		
D. No dung.									
1. No hoofs or bone-meal ...	0.85	5.99	8.29	6.91	6.46	28.5	42.7	88	100
4. " " " " " " ...	0.46	5.88	11.6	10.3	7.76	36.0	54.0	112	
2. Hoofs ... " " " " ...	0.84	6.35	8.16	9.67	7.28	32.3	48.5	100	100
6. Bone-meal ... " " " " ...	1.22	7.59	10.2	8.63	6.26	33.9	50.9	105	111
3. " " " " " " ...	0.65	5.84	12.9	9.73	8.28	37.4	56.1	116	
5. Hoofs and bone-meal ...	0.68	7.56	10.3	9.50	7.56	35.6	53.3	110	110
F. Loam 2 parts, dung 1 part.									
1. No hoofs or bone-meal ...	1.40	8.50	11.9	8.59	9.91	40.3	60.5	99	100
4. " " " " " " ...	0.38	6.40	14.8	7.92	11.6	41.1	61.7	101	
2. Hoofs ... " " " " ...	0.92	7.51	12.8	7.96	9.71	38.9	58.3	95	121
6. Bone-meal ... " " " " ...	0.63	6.99	12.1	7.49	9.29	36.5	54.8	90	93
3. " " " " " " ...	0.70	6.00	13.0	8.60	10.8	39.1	58.7	96	
5 Hoofs and bone-meal ...	0.98	5.70	12.5	8.56	8.78	36.5	54.7	89	113
E. Loam 1 part, dung 1 part.									
1. No hoofs or bone-meal ...	1.12	8.52	11.4	8.76	10.7	40.5	60.7	100	100
4. " " " " " " ...	0.70	6.90	12.9	8.90	11.2	40.6	60.9	100	
2. Hoofs ... " " " " ...	1.41	7.75	12.5	7.54	10.5	39.7	59.6	97	123
6. Bone-meal ... " " " " ...	1.14	7.91	11.2	7.55	11.3	39.1	58.7	96	97
3. " " " " " " ...	0.60	7.00	13.5	8.00	10.6	39.7	59.5	98	
5. Hoofs and bone-meal ...	1.25	8.20	10.6	7.65	11.6	39.3	58.9	97	122
C. Loam 1 part, dung 1 part.									
(a.) Good Soil.									
1. No hoofs or bone-meal ...	—	9.55	13.7	9.32	6.83	39.4	59.1	106	109
3. " " " " " " ...	—	8.60	14.8	9.41	7.89	40.7	61.0	109	
5. " " " " " " ...	—	6.45	14.8	11.6	8.85	41.7	62.5	112	
7. " " " " " " ...	—	3.80	14.3	11.3	10.9	40.3	60.5	109	
(b.) Poor Soil.									
2. No hoofs or bone-meal ...	—	6.34	15.8	8.36	6.40	36.9	55.5	103	100
4. " " " " " " ...	—	6.81	11.6	8.02	7.07	33.5	50.2	90	
6. " " " " " " ...	—	4.32	13.3	12.4	9.18	39.2	58.8	105	
8. " " " " " " ...	—	4.84	15.7	11.1	7.46	39.1	58.6	105	

* Due allowance being made for the smaller number of plants per plot in C.

exactly the same as that produced by 50 per cent., namely, an increase of 19 per cent.; and in connection with this it may be called to mind, that where a still larger proportion of dung was used in some experiments in Series C. in 1917—though they were not strictly comparable with those in the other houses—an actual decrease in the crops was produced. The increase in crop produced this year by dung is on the average less than half of that produced in 1917, though it is somewhat greater than that in 1916.

The lower half of Table VIII. exhibits the results from the point of view of phosphatic manures, and here the conclusions must be of a negative character, for the average increase obtained by the addition of such manures is only 2 per cent. It is true that in both cases where hoofs have been used, the aver-

ages are somewhat higher—4 and 3 per cent.—but it would be rash to conclude at present that this superiority is established, for, when the values for the individual seasons are examined, it is found to hold good in only 12 cases out of the 22 available.

Table VIII.

Summary of Manurial Experiments in Cucumbers 1916-18.

Treatment.	Year.	No Dung.	Dung 33%.	Dung 50%.
No hoofs or bone-meal	1916	—	108	106
" " " " " " " " " " " "	1917	100 } 100	149 } 128	146 } 126
" " " " " " " " " " " "	1918	100	126	126
With hoofs	1916	—	113	105
" " " " " " " " " " " "	1917	100 } 100	137 } 123	148 } 125
" " " " " " " " " " " "	1918	100	120	123
With bone-meal... ..	1916	—	110	89
" " " " " " " " " " " "	1917	100 } 100	123 } 113	128 } 109
" " " " " " " " " " " "	1918	100	106	111
With hoofs and bone-meal ...	1916	100	114	102
" " " " " " " " " " " "	1917	100 } 100	124 } 114	144 } 119
" " " " " " " " " " " "	1918	100	103	111
Mean of all the Series	1916	100	111	100
" " " " " " " " " " " "	1917	100 } 100	133 } 119	141 } 119
" " " " " " " " " " " "	1918	100	114	118
Average	1916-18	100	119	119

Treatment.	Year.	No Hoofs or Bone-meal.	Hoofs.	Bone-meal.	Hoofs and Bone-meal.
No dung	1916	—	—	—	—
" " " " " " " " " " " "	1917	100 } 100	113 } 106	114 } 113	114 } 112
" " " " " " " " " " " "	1918	100	100	111	110
33 per cent. dung ...	1916	100	105	102	106
" " " " " " " " " " " "	1917	100 } 100	103 } 101	94 } 96	95 } 97
" " " " " " " " " " " "	1918	100	95	93	89
50 per cent. dung ...	1916	100	100	84	96
" " " " " " " " " " " "	1917	100 } 100	114 } 104	100 } 94	112 } 102
" " " " " " " " " " " "	1918	100	98	97	97
Mean of all the Series	1916	100	103	93	101
" " " " " " " " " " " "	1917	100 } 100	110 } 104	103 } 99	110 } 103
" " " " " " " " " " " "	1918	100	98	100	99
Average	1916-18	100	104	99	103

Effect of Manure on character of growth.

In spite of this absence of effect on the total crops, both bone-meal and hoofs appear to make the foliage firmer and more robust, as was specially seen this year when the Leaf-Spot Disease—*Cercospora melonis*—developed in the houses.

As was pointed out in the last Report, the value of dung in the border is physical as well as chemical, for in decomposing it warms the borders in the early stages, and it also promotes openness of the soil. The average temperature of

the borders at the time of planting-out was 61°F in Series D, (no dung), 65°F in Series F (33% dung), and 73°F in Series E (50% dung). The root action was also best in Series E and resulted in a quicker growth. The stems were, however, thinnest in Series E, showing, on March 23rd, an average of 33 internodes as against 29 and 31 respectively in Series D and F. There were also fewer laterals in Series E—12 as against 14 and 15 in Series D and F respectively—indicating less robust growth than where less dung was used.

(b.) The Manuring of Tomatoes.

The two problems which have been under investigation during the last three years, are (1) the general manurial requirements of tomatoes, and (2) the sufficiency or otherwise of the dressings usually regarded as necessary by the growers of the district. The plan for the investigation of the first problem was to have one completely manured plot, and others from which one of each of the three fertilising constituents, nitrogen, phosphates and potash, was left out; in addition to which there was a plot with a complete artificial manure and with dung in addition. The results from the two series, with different varieties, are again satisfactorily concordant, and the mean given by them will be found in the last column of Table IX.

These experiments must be continued for several years more before definite evidence as to the exhaustion of the soil by withholding one or other of the constituents of the manure can be expected. An examination of the results during the past three years should, however, give some indication of the direction in which the results are tending. Consequently, a summary of the values has been set out in Table X., and on looking at the mean results from the two houses, as given in columns 8—10, one feature becomes very apparent, namely, that in every case (except, of course, No. 5 which has been taken as the standard of comparison), there is a continuous falling-off of crops in the successive years. This, however, may be apparent only, due to a rise, accidental or otherwise, in the crops from the plot with which all the others are compared (No. 5), and that it is so, seems very evident from the fact that similar falling-off is indicated in Plot 4, where there was the same complete manure used as in Plot 5, as well as dung in addition to it. The values with the standard dressings also show a falling-off, and here, also, it is impossible to attribute this to the withholding of any of the constituents of the manure. The safest method of examining the results in such a case is (at any rate, as a first approximation), to compare all the values, not with No. 5, which appears to be faulty, but with the averages of all the plots. This has been done; and the results are given in columns 12—14. On looking at these it will be seen that there are only three cases in which a definite variation throughout

Table IX.
Manurial Experiments with Tomatoes.

Crops in lbs. per plant, grown on plots (25 ft. by 12 ft.) containing 120 plants,
and occupying 1/145th of a house-acre.

PLOT NUMBER AND TREATMENT.	Series J. Variety "Comet."							Series K. Variety "Kondine Red."							Mean of Two Series.		
	Lbs. during				Total.			Lbs. during				Total.				Relative.	
	June.	July.	Aug.	Sept.	Oct.	Lbs. per plant.	Tons per acre.	June.	July.	Aug.	Sept.	Oct.	Lbs. per plant.	Tons per acre.			
5 Complete Artificials ...	0.26	1.74	0.24	0.49	*	0.59	3.32	25.8	100	0.42	2.40	0.35	0.42	0.53	4.12	32.1	100
6 Artificials without phosphates; no dung.	0.32	1.72	0.22	0.44	0.50	3.20	24.8	97	0.63	1.97	0.31	0.32	0.39	3.62	28.1	88	93
7 Artificials without nitrogen; no dung ...	0.42	2.06	0.25	0.44	0.45	3.62	28.2	109	0.74	2.24	0.33	0.40	0.51	4.22	32.8	102	106
8 Artificials without potash; no dung ...	0.33	1.63	0.19	0.22	0.39	2.76	21.5	83	0.53	1.92	0.26	0.32	0.36	3.39	26.3	82	83
4 Complete Artificials with added dung...	0.36	1.74	0.35	0.54	0.46	3.45	26.8	104	0.51	1.86	0.48	0.41	0.40	3.66	28.5	89	97
2 Half-standard Manurial Treatment ...	0.22	1.51	0.25	0.38	0.43	2.79	21.7	84	0.35	1.83	0.40	0.47	0.43	3.48	27.1	84	84
1 Standard Manurial Treatment ...	0.19	1.52	0.21	0.47	0.53	2.89	22.5	87	0.35	1.64	0.35	0.44	0.48	3.26	25.3	77	82
3 Double-standard Manurial Treatment ...	0.24	1.72	0.32	0.52	0.47	3.27	25.4	99	0.48	2.00	0.51	0.51	0.46	3.96	30.7	96	98

* Including small pickings in November.

the three years is exhibited. One of these, of course, is the anomalous increase shown by Plot 5, the other two being cases where there appears to be a steady decrease—No. 8 in which potash is omitted, and No. 2 in which only half the standard dressing is applied. Gradual exhaustion in this latter case is very easily intelligible, and gradual exhaustion due to omission of potash is equally so, and must be a point of considerable importance to growers. Its probable occurrence has already been indicated in former reports.

Table X.
Summary of Manurial Experiments with Tomatoes, 1916-18.

Plot Number and Treatment.	House 3.						House 4.			Mean of Two Houses.			
										(a) Compared with No. 5.		(b) Compared with the average.	
	1916 2	1917 3	1918 4	1916 5	1917 6	1918 7	1916 8	1917 9	1918 10	1916 11	1917 12	1918 13	1919 14
5 Complete Artificials	100	100	100	100	100	100	100	100	100	100	89	102	108
6 Artificials without phosphates; no dung...	102	97	97	104	103	88	103	100	93	99	92	102	99
7 Artificials without nitrogen; no dung ...	119	110	109	114	108	102	117	109	106	111	104	111	114
8 Artificials without potash; no dung...	119	91	83	114	92	82	117	92	83	97	104	93	89
4 Complete Artificials with added dung ...	121	105	104	100	101	89	111	103	97	104	98	105	103
2 Half-standard Manurial Treatment	119	90	84	120	95	84	120	93	84	99	106	94	91
1 Standard Manurial Treatment	117	78	87	121	91	77	119	85	82	95	106	87	89
3 Double Standard Manurial Treatment ...	117	106	99	114	101	96	116	104	98	106	103	106	105
Average	—	—	—	—	—	—	113	98	93	101	—	—	—

It may be noted that once the results which show peculiarities have been ascertained, these should be omitted in deducting the averages for the standard of comparison, and all the values recalculated with this improved standard. This has been done; but the alterations produced are too insignificant to require special mention at present.

The persistent increase in crop through the omission of nitrogen in Plot 7, and the absence of benefit from the addition of extra nitrogen in the form of dung, as in Plot 4, is very noticeable, especially in view of the general belief in the efficacy of nitrogen in tomato culture, and of its undoubted efficacy in the case of cucumbers. As pointed out in our last report, such results may imply a fundamental physiological difference between cucumbers and tomatoes, and, in any case, it is a subject which calls for further investigation. It is proposed to modify this series of experiments next season. Whilst Plots 4, 5, 6, 7 and 8 will be continued as before, Plot 1 (standard treatment) will be made a double artificial plot (*i.e.* double Plot 5), Plot 2 will be kept as an unmanured plot, and Plot 3 (double-standard) will be given a standard dressing in the winter, and top-dressed with complete artificials, as in Plot 5, during the summer.

In this way we shall get a more connected series of experiments from which it is hoped additional information will be forthcoming.

The Value of Soil in Cucumber Culture.

The last entries in respect to Series C. which appear in Table VII., refer to an experiment made to ascertain the relative importance of the nature of the soil, as compared with other factors, in cucumber culture. Two soils were imported to the Station, one of which had given remarkably good crops over a number of years, this was used in Plots C. 1, C. 3, C. 5 and C. 7; whilst the other was a soil that had failed to give satisfactory results, and was used in Plots C. 2, C. 4, C. 6 and C. 8. The manurial treatment was identical with that given in Series E., Plots 1 and 4, the soils being mixed with an equal quantity of dung, but no phosphatic manure being added to them.

The results obtained with the good soil were practically identical those obtained with the soil from the Station in Plots E. 1 and 4, Table 7, namely, 40.5 lbs. per plant, against 40.55 lbs., whilst the crop from the poor soil, 37.2 lbs. per plant, was only 9 per cent. lower. In view of the fact that the soils had been mixed with 50 per cent. of dung, no greater difference, perhaps, was to be expected.

Plots C. 1 to C. 4 inclusive were in the part of the house nearer the boiler, which is supplied with an extra pair of heat-

ing pipes, and Plots C. 5 to C. 8 inclusive were in the half of the house more remote from the boiler, the average difference in air temperature being 4°F. The differences due to proximity or otherwise to the warmer end are more marked in the case of the poor soil than in that of the good soil.

Report on the work of the W. B. Randall Research Assistant.

Mr. W. B. Randall having on April 11th placed at the disposal of the Committee a sum of money to defray the cost of a special Research Assistant, Mrs. D. J. Matthews (Miss Isgrove), was appointed to the post on the same day, and took up her duties on April 22nd.

Mrs. Matthews' work was to study the problems arising out of the use of chemical sterilising agents in the growth of tomatoes under glass.

The work is still continuing and it must be clearly understood that the present report is of an interim nature only and allows as yet of no rigid conclusions.

The general method of procedure is to make laboratory tests showing the effect of various sterilising agents on the soil pests affecting tomato houses, and then to lay out plots in commercial nurseries affected by some of these soil pests and see how the suggested remedies answer in practice.

A considerable number of substances are being examined, but much time was absorbed in finding useful methods of rapid testing. The final test is of course the actual plant, but some quicker method has to be adopted for the preliminary sorting out. The greater part of the work is not yet ready for publication, but some of the results obtained with the standard substances are given here.

Six pests have been studied; wireworms, club, *Fusarium* and root fungus, the ill-defined soil sickness, and "sleepy" disease.

STEAM.—In laboratory tests steam is a complete remedy for all these troubles, but in commercial nurseries it has not invariably proved successful. In at least two instances *Fusarium* occurred on the steamed plots, though, as straw manure was brought in *after* steaming it is possible that the fungus was re-introduced with the manure; this is being further tested. In our experiments steam has invariably killed club and root fungi and eradicated sleepy disease; wireworms, however, have occasionally escaped, presumably because they were deep down in the soil. Strong, clean white roots were produced.

Steaming should be done in winter or early spring; if it is done late it retards fruiting. The following figures illustrate this:—

Early pickings, lbs. per plant.			
	Nursery No. 2.		Nursery No. 4.*
	June.		August.
Untreated.....	0.51		0.26
	0.50		
Steamed	0.36		0.21
	0.31		

} a difference
of 25%.

*First five pickings end of August, plants being late planted.

HOT WATER.—The effectiveness of hot water necessarily varies with the temperature, and in favourable cases approximated to the effect of steaming. Where wireworm, root knot and sleepy disease still occurred the water was probably too cold at the time of application. In one experimental house plenty of fibrous roots were formed, but in no case were the roots so clean as when the soil was steamed.

TAR ACIDS.—Liquid carbolic acid, more properly called cresylic acid, is effective against sickness. It reduces club and is tolerably satisfactory so long as the pest is not too abundant, but in bad cases it does not always act to any great extent in the first year. It does not kill wireworms, indeed some growers think that it intensifies the wireworm trouble; it is liable to check root growth, which would tend to make wireworm attacks more serious. Nor is it effective against sleepy disease and root fungus. In Nursery No. 3, where a bad attack of wireworm and root fungus had reduced the ground almost to sterility, cresylic acid was not strikingly successful, some plants showed good clean roots, while others had crippled main roots, and many died of sleepy disease. Laboratory experiments show that it kills fungi only at very high concentrations which could not possibly be used in practice.

FORMALDEHYDE.—This is specific in its effect; where it acts it does well. In Nursery No. 1 in 1917 it gave even cleaner roots than steam treatment, but they were less robust. Against root knot and wireworm, however, it is not effective, nor can it be relied on against sleepy disease.

NAPHTHALENE AND LIME.—These have proved disappointing and we have had no success with them.

The following is the order of merit of the agents tried when judged by the power of inducing clean strong roots in diseased soil:—

Nursery No. 1.	Nursery No. 2.	Nursery No. 3.
Steam	Steam	Steam
Formaldehyde	Hot Water	Hot Water
Hot Water	Cresylic Acid	Cresylic Acid
Cresylic Acid	—	Formaldehyde
Lime	—	Lime
Naphthalene	—	—

The agreement is very close; steam is invariably first, followed by hot water and cresylic acid; lime and naphthalene come last. Formaldehyde shows widest variation; in No. 1 it succeeds, in No. 3 it practically fails.

Effect of Sterilisation on Crop Yield.

The Experiment Station undertook experiments in three nurseries to determine the effect of sterilisation on growth and yield. The tomatoes received the customary treatment at each nursery; the usual manuring, top dressings, &c., were given. The results are given in Table XI.; in going over them it must be remembered that the top dressings mask the fertilising effect of the sterilisation and that the figures are to be read in conjunction with the results set out above.

The Experimental Station continued the experiments in the two trade nurseries (Nurseries Nos. 1 and 2) mentioned in the last report, and in June, 1918, took over two more narrow tomato houses at a third nursery (Nursery No. 3).

At Nursery No. 1, where two houses were available, each house was divided into eight equal plots, and the following treatments were given: Steam (two plots); hot water; naphthalene (four ozs. per square yard); formaldehyde (one-ninth gallon of 40% solution per square yard); lime (four lbs. per square yard); commercial pale straw liquid "carbolic acid" (more appropriately termed cresylic acid) 97/99% (one-ninth gallon per square yard). One plot was left untreated in each house. At this nursery, where the houses are 19 years old, there was a good deal of root-knot eelworm (*Heterodera radialis*).

At Nursery No. 2, where only one house was available, 8 plots were set out, and the following treatments were given: Steam (two plots); hot water (two plots); "carbolic acid" (two plots), and two plots were left untreated. The houses at this nursery are 12 years old, and for some years the soil had shown a steady decrease in cropping power, in spite of adequate manurial treatment, being what is technically termed "sick"; this year, there is a certain amount of "club" all over this nursery, so that considerable importance was attached to the condition of the roots at the conclusion of the experiments.

At Nursery No. 3, two houses which had failed to give a satisfactory crop were taken over by the Committee of Management at the end of June, each house being divided into 32 small plots or "bays." The following treatments were given: House No. 31—Steam (five bays); hot water (five bays); "carbolic acid" (five bays); extra straw manure and basic slag (five bays); lime (seven bays); and five bays were left untreated. House No. 32—"Carbolic acid," followed by cold water (six

Nursery No1 - House A.

1918	Steam ⁵	Carbolic acid ⁶	Formaldehyde ⁷	Hot water ⁸
	Naphthalene ⁴	Lime ³	Untreated ²	Steam ¹
1917	Steam ⁵	Carbolic Acid ⁶	Formaldehyde ⁷	Hot water ⁸
	Naphthalene ⁴	Lime ³	Untreated ²	Steam ¹

— South —

Nursery No.1 - House B.

1918	Carbolic Acid ⁵	Steam ⁶	Hot water ⁷	Formaldehyde ⁸
	Lime ⁴	Naphthalene ³	Steam ²	Untreated ¹
1917	Untreated ⁵	Untreated ⁶	Untreated ⁷	Cold water ⁸
	Untreated ⁴	Untreated ³	Untreated ²	Untreated ¹

— South —

Nursery No2.

1918	Steam ⁵	Carbolic Acid ⁶	Untreated ⁷	Hot water ⁸
	Hot water ⁴	Untreated ³	Carbolic Acid ²	Steam ¹
1917	Steam ⁵	Carbolic Acid ⁶	Formaldehyde ⁷	Hot water ⁸
	Naphthalene ⁴	Lime ³	Untreated ²	Steam ¹

— North —

Nursery No.3-1918 only.

House 31. House 32	Untreated ⁶		Cold water ⁵	Formaldehyde ⁴	Formaldehyde ³	Carbolic Acid and hot water ²	Carbolic Acid and cold water ¹
	Lime ⁶	Extra Manure ⁵	Untreated ⁴	Carbolic Acid ³	Hot Water ²	Steam ¹	

— North —

— Diagram to show arrangement of soil sterilisation experimental plots in —
— trade nurseries 1917-1918 —



bays); "carbolic acid," followed by hot water (six bays); formaldehyde (one-ninth gallon of 40% solution per square yard) (two bays); formaldehyde (one-eighteenth gallon per square yard) (four bays); cold water (two bays); and twelve bays were left untreated. No records of fruit pickings were kept at this nursery this year, the series of experiments being regarded as qualitative only, with a view to a more extended and quantitative series of experiments next season, when six houses will be available for the purpose. It is proposed that one house shall be steamed right through, another will be divided into four plots, two of which will be treated with "carbolic acid" and two with hot water; two whole houses will be kept untreated as controls, and the two houses which were treated in various ways this year will be left untreated, in order to obtain information as to the effect of the previous treatments on the subsequent season's crops.

As regards the results obtained last year, those in Nursery No. 1 are almost entirely negative; of the six methods of treatment applied in the two houses, five of them yield opposite crop results in the one house to what they do in the other, that is, in one house they are greater and in the other house less than the untreated plots; the only exceptional case being that of formaldehyde, where, however, the benefit in the case of House A is only 6 per cent. The average of the treated as compared with the untreated plots is 7 per cent. in favour of the former; last year it was —1 per cent.

A comparison of this year's and last year's results emphasises these negative results, and renders it doubtful whether any additional crop can be attributed to any one of the special forms of treatment apart from the effect on disease organisms already mentioned. Thus:—

	Untreated.	Carbolic.	Formaldehyde.	Steam.	Lime.	Hot Water.	Naph.					
1917—100	...	105	...	115	...	112	...	109	...	102		
1918—100	...	107	...	103	...	95	...	95	...	96	...	92

Again it should be mentioned that the usual top dressings were applied to all the plots.

Last year an examination of the results in the earlier and latter portions of the season suggested that benefit had (to the extent of 9 per cent.) been derived from the treatment at first, and that subsequently this had been reversed. This was not stated in the report, as the fact seemed to require confirmation, and this caution appears to have been justified, for no alteration in behaviour of the plants during the season is apparent this year, the treated plots during June and July giving a relative value of 106.4 and during the rest of the season of 107.6. A similar examination of the values for each successive month led to no definite results.

In the case of Nursery No. 2, where the main soil-malady is the indefinable "sickness," the results are of a more positive character, the average benefit from treatment being 10 per cent. As will be seen from the plan (Fig. 2), the house was divided so that each experiment was repeated in one half of it, and in the two halves the results agree in attributing benefit to all the treatments applied, though the absence of uniformity as regards the values for the individual forms of treatment renders it impossible to attribute with certainty a superiority to any one of them.

	North End.	South End.	Average.
Steam.....	114	103	109
Hot Water.....	112	104	108
Carbolic Acid..	104	120	112
Untreated	100	100	100

At this nursery the south end suffered from cold in the early part of the season, also from a worse attack of wireworms (necessitating more replanting), and this end always takes the "mildew" first. It is very difficult to get equable conditions right through these large houses during a whole season. The differences in the appearance of the plants when growing were not very marked. Plot 7, which was treated with formaldehyde last year (untreated this year) showed hard but healthy growth this year, and was at all times much better than Plot No. 3 (untreated both years), indicating a certain amount of benefit from the last year's application of formaldehyde.

At this nursery the average crop was higher this year than it has been any year since the first three, the nursery being twelve years old. The average crop this year was 40 tons per acre as against 33 tons per acre during the previous six years, a difference which is attributed chiefly to the nature of the season and to more careful watering.

Preliminary Report on Entomological Research.

The larvae of the Noctuid Moth *Hadena oleracea* were observed in the glass-houses some ten or twelve years ago, but so infrequently as to cause no alarm. Latterly, however, they have become sufficiently abundant to become a serious menace to the industry. Glass-house conditions appear to be extremely favourable to this species and at the same time afford it considerable protection from the attacks of its natural enemies.

LIFE-HISTORY.—The winter is passed in the pupa, and when the houses are heated in the early spring, the moths emerge. The time of emergence appears to depend upon the position selected by the larva for pupation, emergence naturally being delayed where the pupae occur in situations which become only slowly warmed up. The pupae have been found in a variety

of positions, *i.e.*, beneath the soil, on the surface of the soil, in the top joints of the canes, and in crevices between the bricks, &c. The moths emerge at irregular intervals, and are present in the glass-houses for a period of four months (until June). Oviposition is stated to take place from 3–5 days after emergence. The eggs are laid in batches of 10–50 on the under surface of the lower leaves of the plants; they hatch in about 6 days, and the first brood of the caterpillars are at their worst during July. They speedily feed up, pupate, and give rise to the second brood of moths. The latter produce a second generation of caterpillars, which are extremely abundant by the end of August and during September. This brood overwinters as pupae, which give rise to the first brood of moths of the following year.

CONTROL.—1. Spraying with lead arsenate gave excellent results in every laboratory experiment. A proprietary article tested did not give good results, and fumigation with hydrocyanic acid gas was found to be unsatisfactory. 2. Poisoned baits have been suggested and experiments with them will be undertaken. 3. Winter treatment of the soil will also be the subject of experiment.

More exact observations are needed as to the times of appearance of *Hadena oleracea* in its different stages in each generation. Further work is desirable in order to ascertain which situation is most extensively used for purposes of pupation. Carefully conducted spraying experiments are essential, particularly in order to ascertain the number of applications desirable, and the duration of the interval between each application. Some method of attracting and poisoning the moths is also necessary, and requires investigation. Finally, enquiry is needed in order to ascertain the necessity and practicability, or otherwise, of measures for dealing with the pupae in the soil during the winter months, and its relation to soil sterilisation.

APPENDIX.

Top-Dressings for Cucumber Borders, 1918.

Throughout the Series C. to F. inclusive, and in Series X, top-dressings were given every week from March 21st to the end of July, of exactly the same composition as the original borders in each case, no other fertilisers being added at any time. Nineteen top-dressings were given in all, the amounts of each dressing being as follows :—

Series.	Top-dressing.
C. 1, 3, 5 & 7.	$\frac{1}{2}$ barrow good soil, $\frac{1}{2}$ barrow manure and $\frac{1}{2}$ lb. lime to each set of 9 plants.
C. 2, 4, 6 & 8.	$\frac{1}{2}$ barrow poor soil, $\frac{1}{2}$ barrow manure and $\frac{1}{2}$ lb. lime to each set of 9 plants.
D. 1. & D. 4.	$1\frac{1}{2}$ barrows of loam, and $\frac{3}{4}$ lb. lime to each set of 16 plants.
D. 2... ..	$1\frac{1}{2}$ barrows of loam, $\frac{3}{4}$ lb. lime and 9 ozs. hoofs to each set of 16 plants.
D. 3. & D. 6.	$1\frac{1}{2}$ barrows of loam, $\frac{3}{4}$ lb. lime and 1 lbs. 2 ozs. bone-meal to each set of 16 plants.
D. 5... ..	$1\frac{1}{2}$ barrows of loam, $\frac{3}{4}$ lb. lime, 9 ozs. hoofs and 1 lb. 2 ozs. bone-meal to each set of 16 plants.
E. 1. & E. 4.	$\frac{3}{4}$ barrow loam, $\frac{3}{4}$ barrow manure and $\frac{3}{4}$ lb. lime to each set of 16 plants.
E. 2... ..	$\frac{3}{4}$ barrow loam, $\frac{3}{4}$ barrow manure, $\frac{3}{4}$ lb. lime and 9 ozs. hoofs to each set of 16 plants.
E. 3. & E. 6.	$\frac{3}{4}$ barrow loam, $\frac{3}{4}$ barrow manure, $\frac{3}{4}$ lb. lime and 1 lb. 2 ozs. bone-meal to each set of 16 plants,
E. 5... ..	$\frac{3}{4}$ barrow loam, $\frac{3}{4}$ barrow manure, $\frac{3}{4}$ lb. lime, 9 ozs. hoofs and 1 lb. 2 ozs. bone-meal to each set of 16 plants.
F. 1. & F. 4.	1 barrow loam, $\frac{1}{2}$ barrow manure and $\frac{3}{4}$ lb. lime to each set of 16 plants.
F. 2... ..	1 barrow loam, $\frac{1}{2}$ barrow manure, $\frac{3}{4}$ lb. lime and 9 ozs. hoofs to each set of 16 plants.
F. 3. & F. 6.	1 barrow loam, $\frac{1}{2}$ barrow manure, 1 lb. 2 ozs. bone-meal and $\frac{3}{4}$ lb. lime to each set of 16 plants,
F. 5... ..	1 barrow loam, $\frac{1}{2}$ barrow manure, $\frac{3}{4}$ lb. lime, 9 ozs. hoofs and 1 lb. 2 ozs. bone meal to each set of 16 plants.
X. 1—18 ...	$\frac{3}{4}$ barrow of loam, $\frac{3}{4}$ barrow manure and $\frac{3}{4}$ lb. lime to each set of 16 plants (4 small borders of 4 plants each).

Dates of Sowing, Potting, Planting, Picking, &c., 1918.

Crop.	Sown.	Pricked off.	Potted into 60's.	Potted into 32's.	Planted out in borders.	Mulching.	First Top Dressing.	First Fruit Picking.	Last Fruit Picking.
Tomatoes (Isolation House) ...	Jan. 1	Jan. 12	Feb. 18	—	Mar. 21	May 27	June 12	May 29	Nov. 5
Tomatoes (Large Houses) ...	Jan. 2	Jan. 13	Feb. 19	—	Mar 12-15	June 5-7	June 12	June 1	Nov. 5
Cucumbers in borders ...	Dec. 28, 1917.	Jan. 1	Jan. 5	Jan. 29	Feb. 21-23	—	Mar. 21	Mar. 22	Aug. 3

Tomato Manurial Experiments. Houses 3 & 4. Series J & K.

Eight equal plots of 32 square yards were set out in each house and on each plot 120 plants were grown. The different treatments were as follows :—

- Plot 1. Standard manurial treatment consisting of 2 lbs. lime, 14 lbs. straw manure, $\frac{1}{2}$ lb. bone-meal, $\frac{1}{2}$ lb. bone-flour, $\frac{1}{2}$ lb. ground hoofs, and $\frac{1}{2}$ lb. sulphate of potash per square yard.
- Plot 2. Half the treatment in Plot 1.
- Plot 3. Double the treatment in Plot 1.
- Plot 4. *Complete artificials, lime, basic slag, superphosphate, sulphate of ammonia, nitrate of soda, and sulphate of potash, equivalent in analytical value to the materials given in Plot 2, plus 7 lbs. straw manure per square yard.
- Plot 5. *Complete artificials as in Plot 4, but no straw manure.
- Plot 6. *Complete artificials as in Plot 5, but omitting phosphates,
- Plot 7. *Complete artificials as in Plot 5, but omitting nitrogen.
- Plot 8. *Complete artificials as in Plot 5, but omitting potash.

*The quantities given in Plots 4 to 8 were as follows :—

Plot 4. **Before planting.** 1 lb. lime, 7 lbs. straw manure, 0.4 lb. basic slag, and 0.1 lb. sulphate of potash per square yard.

After planting in four equal instalments. 0.2 lb. sulphate of ammonia, 0.2 lb. nitrate of soda, 0.5 lb. superphosphate, and 0.2 lb. sulphate of potash per sq. yd.

- Plot 5. Same as Plot 4 with the omission of straw manure.
- Plot 6. Same as Plot 4 omitting straw manure, basic slag, and superphosphate.
- Plot 7. Same as Plot 4 omitting straw manure, nitrate of soda, and ammonium sulphate.
- Plot 8. Same as Plot 4 omitting straw manure and sulphate of potash.

No mulching or top-dressing other than the above was given in the Series J and K. (Corresponding to Series T and U respectively of 1916.)

For analyses of various materials used see Appendix, Second Annual Report 1916.

STATISTICAL ADDENDA.

Cucumbers.				Tomatoes.			
Number of experimental borders...	..	...	44	Number of experimental plots ...	...	...	72
Total number of plants ...	...	...	432	Area of plots in parts of acre ...	...	...	0.3086
Equivalent number of plants per acre ...	...	...	3360	Total number of plants ...	...	...	4838
Total fruit picked—in tons ...	...	...	8.9	Equivalent number of plants per acre..	...	...	15680
Equivalent tonnage per acre ...	...	...	69	Total fruit picked—in tons ...	...	...	9.55
Average yield of fruit in lbs. per plant...	...	...	46	Equivalent tonnage per acre ...	...	...	31
Total number of flats* sent to market ...	...	...	† 553	Average yield of fruit in lbs per plant	...	...	4.43
Average weight of fruit per flat in lbs. ...	...	...	36	Total number of strikes* sent to market	...	...	† 1783
Number of flats per foot run of house ...	...	...	1.28	Weight of fruit per strike in lbs. ...	...	...	12
* Flats are baskets in which cucumbers are packed according to size, so that a specified number of dozens fills the basket when packed with hay and tissue paper in four layers. The internal dimensions of a flat are 21 ins. by 15 ins. by 9 ins. † Consisting of 12.2-dozens, 27 2½-dozens, 153 3-dozens, 183 3½-dozens, 108 4-dozens, and 70 crooks and smalls.				* Strikes are baskets holding 12 lbs. of fruit, graded according to size and quality from Pinks down to Chats. † Consisting of 293 Pinks, 499 Pink and Whites, 393 Blues, 447 Whites, and 151 Blue and Whites.			

For sizes of the Culture Houses, and the arrangement of the experimental borders and plots, see frontispiece.

**Notes on the weather, from the grower's point of view,
of the Season 1918.**

JANUARY.—The weather of this month was of a wintry nature, cold north-east winds prevailing during the first half of the month. A fair amount of snow fell and the nights were frosty. About the middle of the month there was quite a nice amount of sunlight, and on the 18th a thaw set in, followed by heavy rains, which caused floods in the Lea Valley. The mild weather continued till the 26th when frosts returned, and cold weather prevailed till the end of the month. On the whole the weather conditions were not unfavourable to the raising of seedlings, provided an adequate amount of artificial heat could be maintained.

FEBRUARY.—The weather this month was generally mild, accompanied by a fair amount of sunlight.

MARCH.—During the early part of the month the weather was cold and dull, with very little direct sunlight. An improvement set in just before the middle of the month, but lasted less than a week, when the dull cold weather returned. During the last few days, however, more genial conditions prevailed.

APRIL.—On the whole this was a dull, cold and sunless month. During the first half of the month a considerable amount of rain fell and the Lea Valley was again badly flooded.

MAY.—During the early part of the month the weather was cold and dull, and there was little sunlight. Growers, generally, complained of the lateness of their crops. Near the end of the month real May weather set in and continued.

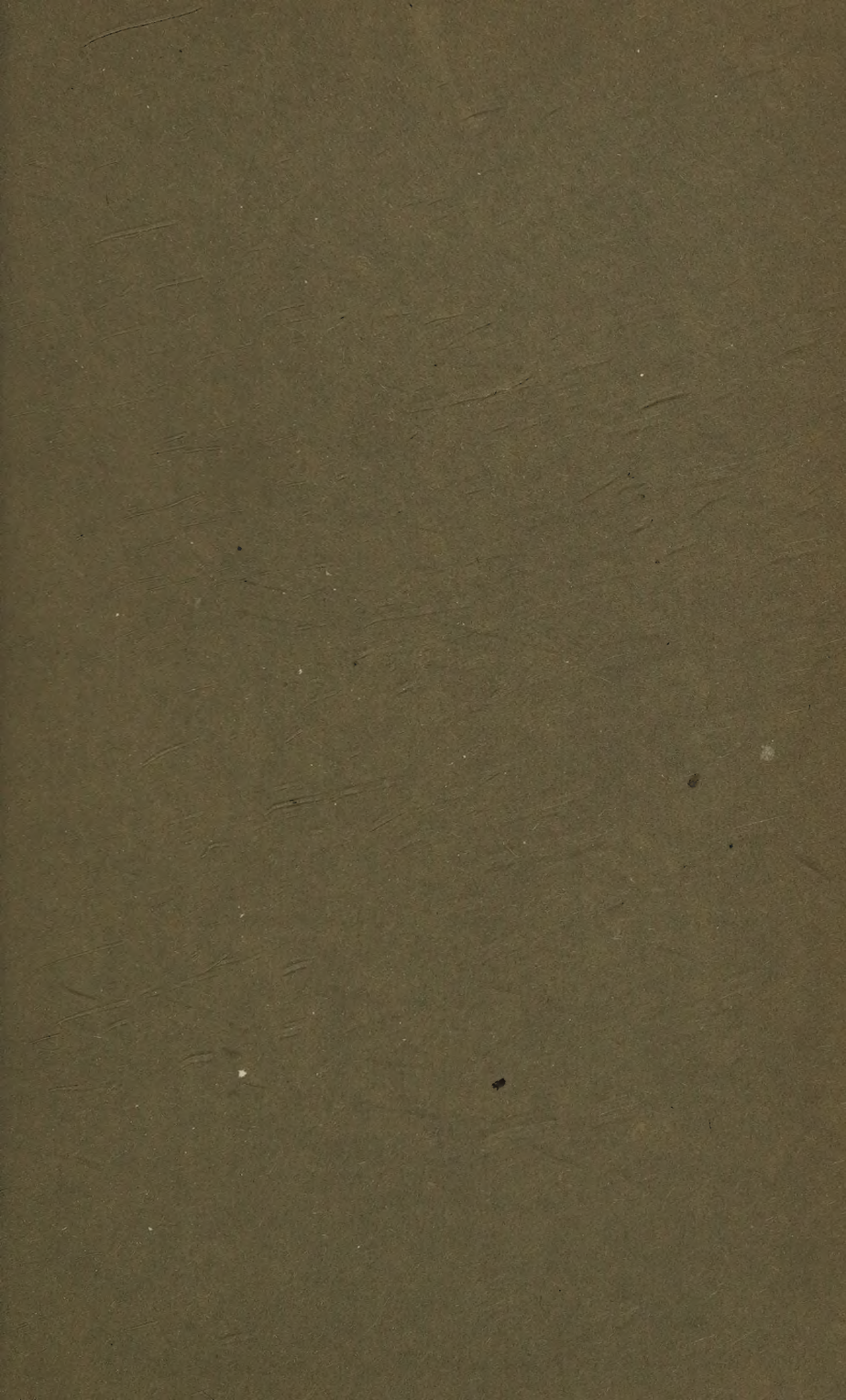
JUNE.—The weather of this month, on the whole, was of a most perfect type—warm and sunny—and was gladly welcomed by all tomato growers.

JULY.—Very similar to June, but with a higher temperature.

AUGUST.—During the early part of the month the weather was most genial, but towards the end it changed, and took on quite an autumnal character, both days and nights.

SEPTEMBER.—This was a disappointing month to growers so far as the weather was concerned. Most of the days were cold, wet and dull, often accompanied by a boisterous wind. The amount of rain this month was the heaviest for the year.

OCTOBER.—During the early part of the month the weather was similar to that of September, but it improved rapidly, and the last two weeks were warm and sunny. Heavy mists prevailed at nights.



Meteorological Records, 1918.

Month.	Rain.		Average outside Temperatures.		Bright Sunshine.
	Total fall. 5 inch Funnel Gauge. Inches.	No. of Rainy Days.	Day Maxm. °F.	Night Minm. °F.	Daily average in hours.
January	2.42	18	43.5	32.7	1.51
February	.98	14	47.9	37.5	2.34
March	.86	8	51.4	34.7	4.41
April	4.09	19	50.6	38.0	3.16
May	2.20	11	64.9	46.2	6.80
June	.97	10	66.4	46.9	7.46
July	3.69	17	69.8	53.2	6.27
August	1.51	12	70.7	54.2	6.00
September	6.37	22	61.8	49.0	5.12
October... ..	1.55	16	55.0	42.6	2.52
November	2.59	18	48.3	36.2	1.95
December	2.46	26	49.6	40.1	0.83
Total or Mean...	29.69	191	56.9	42.6	4.03